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SRI CHS11
CHUTE HEIGHT SENSOR

Instruction and Operation Manual

SRI provides a range of services to the sugar milling and sugar refining industry worldwide. These include commercial research and development, operator and supervisor training, consulting, process control and instrumentation, factory and plant design, boiler optimisation, CFD and DEM analysis, and chemical services.

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1.0 General description

The SRI CHS11 Chute Height Sensor measures the level of prepared cane or bagasse in a Donnelly chute feeding a sugar cane crushing mill. Unlike other level sensors, the CHS11 does not require a clear line of sight to the material surface, so accuracy is not affected by steam, vapor or material feeding into the top of the chute.

The CHS11 operates by measuring the electrical conductivity of an array of electrodes mounted in the wall of the chute. The outputs are proportional to the number of electrodes covered with material. A user interface is provided so that the CHS11 can be configured to suit a range of applications. One CHS can be used to measure the level in one or in two chutes.

Conductivity is detected when the bagasse comes in contact with metallic electrodes mounted within the wall of the chute. The presence of the bagasse causes the electrodes to be electrically connected to the body of the metallic chute. The CHS11 electronics measures a small electric current that is fed to each electrode and detects if the current is greater than a threshold indicating that the electrode is covered.

The CHS11 includes a number of features to improve the reliability of detection including programmable threshold and hysteresis. It also has a logic processor that can be configured to ensure that the CHS11 provides the most faithful indication of chute height.

The two 4-20mA current outputs can be used for level indication and for chute height control. Sixteen SPST relay outputs, each corresponding to an electrode, provide a discrete indication of chute height using lights or for connection to digital inputs of an automation system.

The user interface consists of a liquid crystal display and three push button keypad. It shows the output as a percentage and as a graphical representation of chute height and allows the CHS11 to be configured by setting the number of electrodes, threshold, hysteresis, mode and other parameters.

There are 16 electrode inputs for connection to sensors in one or two chutes. Up to 16 sensors may be connected in one chute and 8 + 8 when connected to two chutes. The CHS11 includes two independent sets of configuration parameters for independent operation when used to measure level in two chutes. Aside from the user interface there are two manual adjustments (one per chute) required to set the sensitivity of the detection circuitry.

NOTE:
The minimum moisture content of bagasse for consistent detection by the CHS11 is 45%. Bagasse any drier than this cannot be reliably detected.

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2.0 Specifications

2.1 CHS11 processing unit

Absolute maximum ratings

Supply voltage input (continuous)	28 VDC
Voltage on any sensor inputs	50 VDC
Voltage on current outputs	36 VDC
Relay contact current (continuous)	2 A

Recommended operating conditions

Input supply voltage	24 VDC
Input supply voltage ripple	< 0.1 V
Power supply rating (no derating)	15 W
Ambient temperature	$25 \pm 5^{o}C$
Ambient humidity	$55 \pm 10\%RH$

Electrode interface and conductivity detector characteristics

Specification	Min	Typical	Max	Unit
Cable length from CHS to electrodes	-	-	25	metres
Detection signal frequency	-	1.92	-	kHz
Detection signal amplitude (no load)	-	5	-	V_{pk-pk}
Threshold adjustment limits	0		5	V_{pk-pk}
Sensor scan rate	-	24	-	Hz
Detection signal source impedance (approx.)	360	-	50 k	Ω
Sensitivity adjustment range	-	50 k	-	Ω
Bagasse moisture content	45	-	-	%

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Supply

Specification	Min	Typical	Max	Unit
Operating supply voltage range	20	24	26	VDC
Allowable ripple and noise at input	-	-	±0.2	V
Supply current at 24 VDC	0.05	-	0.4	A
Voltage protection: clamping voltage	31	-	45	VDC
Self-resetting fuse break current at 20°C	-	1.8	-	A
Self-resetting fuse hold current at 20°C	-	0.9	-	A

Analogue outputs

Specification	Min	Typical	Max	Unit
Source voltage (with supply voltage of 24 VDC)	-	24	-	VDC
Load resistance	0	250	1000	Ω
Limits of zero (4 mA) adjustment	3.3	-	4.9	mA
Limits of full scale (20 mA) adjustment	19	-	22	mA

Relay outputs

Specification	Min	Typical	Max	Unit
Rated contact current	-	-	2	A
Rated contact power	-	-	60	W
Rated contact voltage (AC)	-	-	24	VAC
Rated contact voltage (DC)	-	-	30	VDC

NOTE:
Relay contacts are not suitable for mains-level voltages (110-240 VAC). Use a separate relay with the appropriate rating if switching mains-level voltages.

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Environmental conditions

Specification	Min	Typical	Max	Unit
Storage temperature range	0	-	70	°C
Operating temperature range	5	-	50	°C
Ambient humidity	20	-	70	%RH
Vibration (10 to 60 Hertz)	-	-	0.02	G
Shock	Not permissible			

Physical characteristics

Dimensions	210 x 90 x 60 mm (WxHxD)
Protection rating	IP00
Material	Polycarbonate
Mounting	35mm DIN
Weight (approximate)	0.3 kg

2.2 AC power

The CHS11 is designed for a nominal 24 VDC input supply. If this is not available, a suitable modular power supply unit is needed in close proximity to the CHS11. The following output specifications are required:

Specification	Min	Typical	Max	Unit
Output voltage	-	24	-	VDC
Output voltage tolerance	-	±10	-	%
Rated output current (no temperature derating)	1	-	-	A
Output ripple at full load	-	-	0.2	VDC

2.3 Processing unit enclosure

The CHS11 is a DIN rail mounted unit, designed for mounting in a control cabinet. If mounted in the field, a suitable IP-rated enclosure is required.

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3.0 Mechanical installation

Details of the CHS11 dimensions, weight and mounting are provided in Section 1.1 of this manual. The CHS11 is designed for mounting in a control cabinet, must not be installed without appropriate protection from the factory environment.

NOTE:
The maximum cable length from any chute electrode to a CHS11 is 25 meters.

3.1 Chutes and electrodes

The CHS11 functions by measuring conductivity between electrodes and the steel wall of the chute. The presence of material (e.g., bagasse or prepared feed) touching both the steel wall and an array of electrodes, positioned vertically in the chute, causes a low resistance path for electric current to flow. This allows the CHS11 to determine that material is present. The low resistance of the bagasse is mostly due to the presence of moisture.

Each CHS11 can be used to monitor one or two chutes. It is possible to have sixteen electrodes in a single chute because there is a limit of sixteen electrode inputs. When one CHS11 is used to measure the level in two chutes (dual chute mode) then each chute may have a maximum of eight electrodes.

The CHS11 requires an even number of electrodes for correct operation. For example, in single chute mode 10, 12, 14 or 16 electrodes shouyld be used. In dual chute mode, each chute can have 2, 4, 6 or 8 electrodes.

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3.2 Electrodes

The CHS11 offers wide sensitivity adjustment to cater for many different variations of electrode placements and arrangements. If the CHS11 is to be used to replace an existing conductivity-based chute height system it is likely the existing electrodes may be reused.

Nonetheless, SRI offers two types of electrodes for new installations, or for situations where existing electrode arrays cannot be reused. Non-insulated electrodes are preferred because they offer the best insulation properties when mounted in a polycarbonate sheet, which in turn gives highest adjustment and best height indication outcomes. If non-insulated electrodes are not suitable, SRI can also provide insulated electrodes suitable for direct mounting in the chute.

The electrode array depends on:

- The number of chutes to monitor (single chute or dual chutes);
- The method of electrode insulation;
- Which face of the chute to install the electrodes (sides, front or back);
- The number of electrodes;
- The positions of the highest and lowest electrodes in the chute; and
- The spacing and position of each electrode.

3.2.1 Non-insulated electrodes

The preferred non-insulated domed electrode is shown in Figure 2.

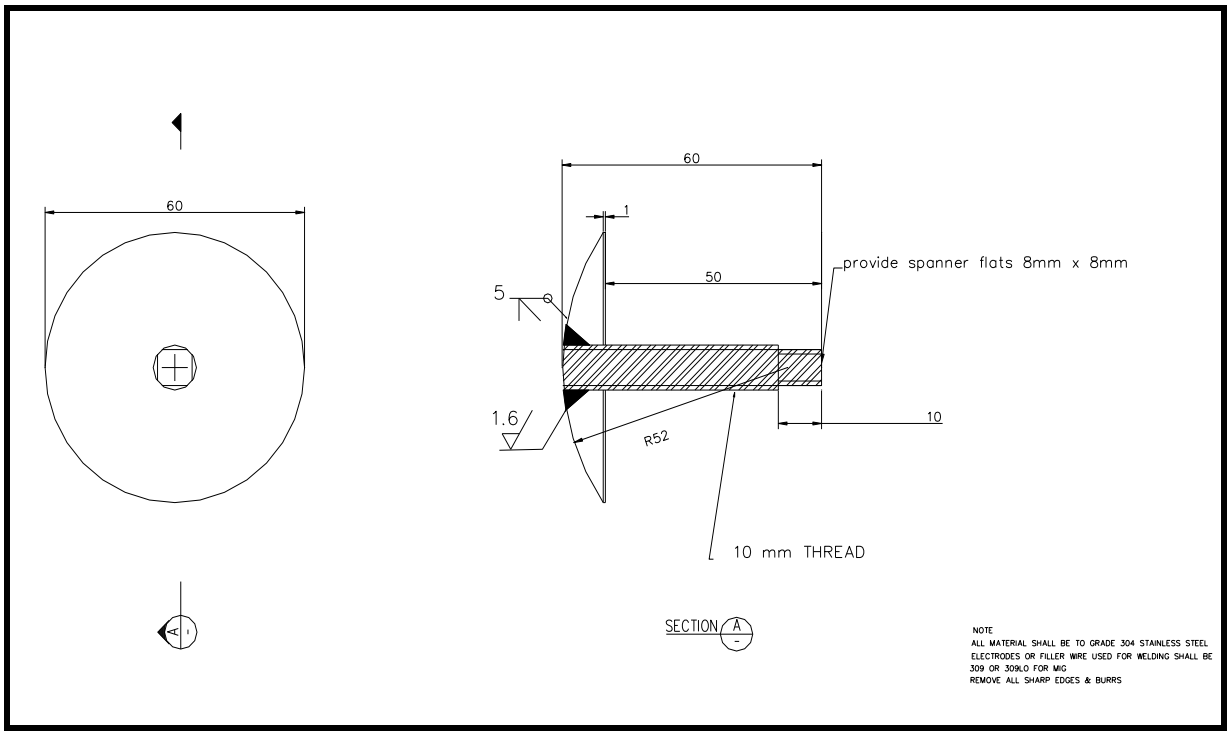

Figure 1: Preferred domed electrode

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The preferred method of insulation is to use a 6mm polycarbonate sheet window to mount a series of the domed electrodes shown in figure 2. A rectangular opening is cut in the steel side of the Donnelly chute – front, back or side surface – to suit the specific site conditions. This arrangement, shown in figure 3, gives good separation between the chute wall and the electrode. There is less chance of "short circuiting" via water tracks or material buildup around the electrode.

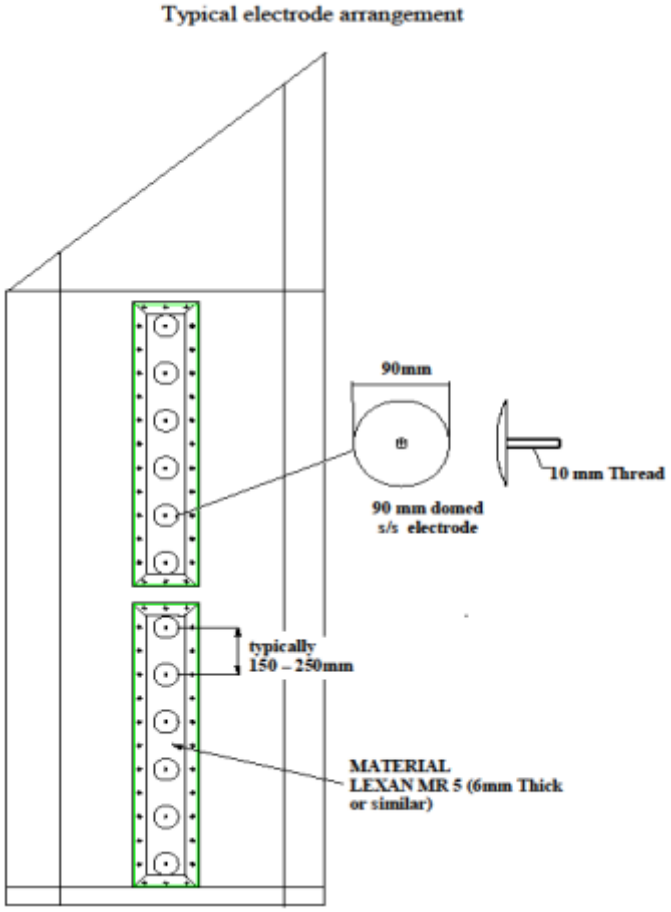

Figure 2: Arrangement of electrodes and polyacarbonate windows in a Donnelly chute

NOTE:
A number of individual windows may be used in one chute in order to place the electrodes in the best location. Using clear polycarbonate windows can help when commissioning the CHS11 because the level of material can be observed and compared with CHS11 output.

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3.2.3 Electrode insulation

Good insulation of the electrodes is very important because any path of electric current that flows between the electrode and steel wall other than through the material may cause false detection. For example:

- Any metallic contact between an electrode and the steel wall will cause a very low resistance. The CHS will falsely indicate that material (bagasse) is present at that electrode. The CHS11 has no means to determine whether a low resistance is due to metallic contact or contact by the bagasse.

- Excess water around the electrode or between the electrode and steel wall may cause a low resistance path when bagasse is not present. Excess water may be water that flows, condenses upon or collects on the inside or outside surface of the steel wall. It may also be water that becomes trapped in the gaps between the electrodes, insulators and steel wall.

The plastic widow should be approximately 200 mm wide and long enough to house the required number of electrodes. The electrodes should be positioned along the centre line of the plastic sheeting and fitted without insulators. In order to mount the electrodes, 10 mm diameter holes must be drilled in the sheeting.

3.2.1 Insulated electrodes

Insulated electrodes may also be used but they are not preferred, as the electrical pathway between electrode and chute is much shorter.

Insulated electrodes are made from stainless steel and have a low profile inside the chute to prevent unwanted material build-up around the electrode. They allow simple direct-to-bulkhead mounting and have two plastic insulation spacers for electrical isolation from the body of the chute. A crimp lug and locknut are provided with the electrode for connection of the cable to the electrode. Figure 3 illustrates the mounting arrangement of electrode in the chute wall.

Insulators are supplied with each electrode and are manufactured from a plastic that is resistant to heat, moisture and mechanical stress. Mounting the electrodes using the spacers requires a 16 mm diameter hole to be cut through the chute wall.

Before fitting the electrodes, liberally coat the steel wall around the electrode mounting holes with a sealing compound such as ‘Silastic’. Coat the inside and outside surface of the wall to prevent moisture collecting under the plastic insulator. Finally fit the electrode with the insulator and wipe off the excess compound after tightening the nut.

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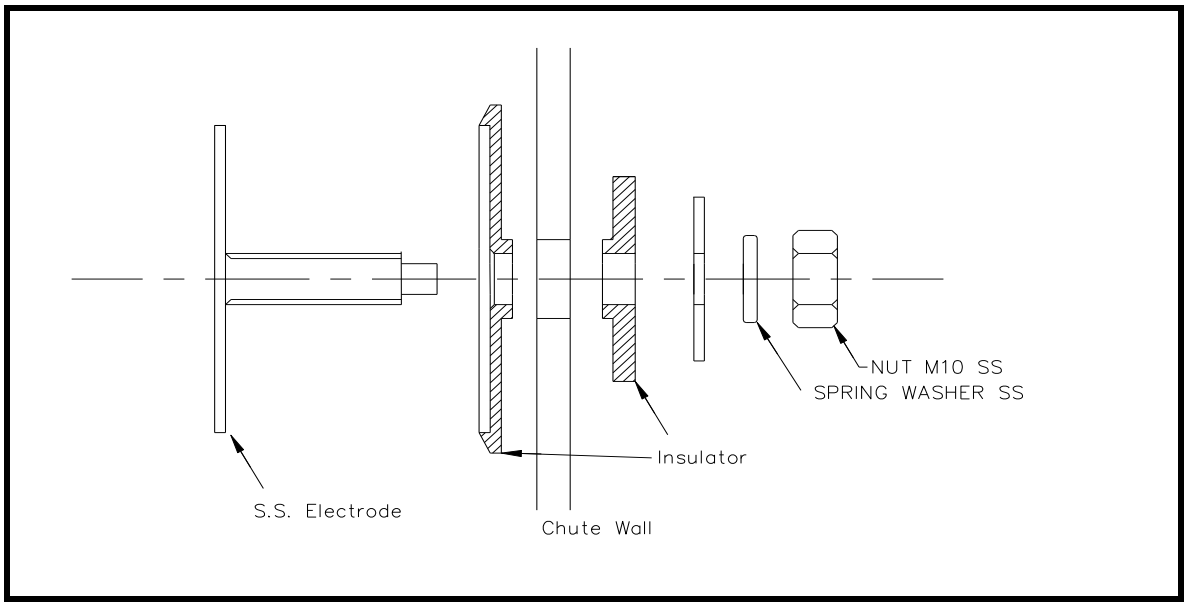

Figure 1: Mounting arrangement of electrode in the chute wall

3.2.4 Chute face

The choice of electrode positioning is determined by the feeding characteristics of the material into the chute. The electrodes must be positioned in a face of the chute where the material firmly contacts the chute wall (without air pockets) and is cleanly removed from the wall when the chute level falls. Efforts should be made to try to locate the electrodes where water is not expected to flow on either surfaces of the chute. Electrodes in the lower part of the chute should not be located where material tends to build up and hang. Figure 4 provides examples of faces where electrodes could be mounted and faces where electrodes should not be mounted.

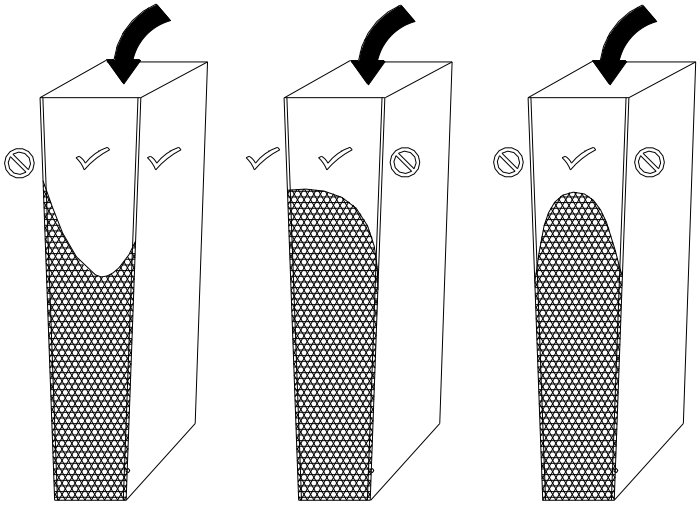

Figure 4: Examples of possible electrode positions

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3.2.5 Number of electrodes

To be effective, in mill control, a CHS11 typically requires eight electrodes to be fitted in the wall of each chute. Using more than eight electrodes will give a better resolution of the output signal.

When used in single chute mode a CHS11 can process inputs from up to sixteen electrodes in the chute. When used in dual chute mode, a CHS11 can process inputs from up to eight electrodes in each chute.

NOTE:
The CHS11 requires an even number of electrodes in each chute.

3.2.6 Highest and lowest electrodes

The positions of the highest and lowest electrodes in the electrode array depend on these factors:

- The CHS11 will indicate that the chute is 100% full when all electrodes are covered. If the highest electrode is placed too high in the chute it may be that the top electrode is never covered and signal resolution is reduced.
- If the highest electrode is placed too low the top electrode may be covered often. If the relay output of that electrode is used for alarm purposes (e.g., a high chute level alarm) there may be too many false alarms.
- The CHS11 will indicate that the chute is 0% full when no electrodes are covered. If the lowest electrode is placed too low in the chute there may be an increased chance of false detection of material. Thus lower areas of the chute may be prone to excess water or to material not being cleared away when the chute is empty.
- If the lowest electrode is placed too high in the chute the ability to use the output signal for alarm purposes (low chute level alarm) may be compromised.

3.2.7 Electrode spacing and position

A typical installation in a Donnelly chute has eight electrodes spaced at approximately 200mm centres in the wall of the chute. The simplest method is to space the electrodes evenly between the highest and lowest electrodes, although this is not the only option. Refer to the Applications Guide in this manual for information on spacing the electrodes at irregular intervals.

To avoid the effects of excess water in the chute, it is recommended to mount the electrodes in a diagonal or staggered geometry so that dripping water corrupts only one electrode. Figure 5 illustrates some possible mounting positions.

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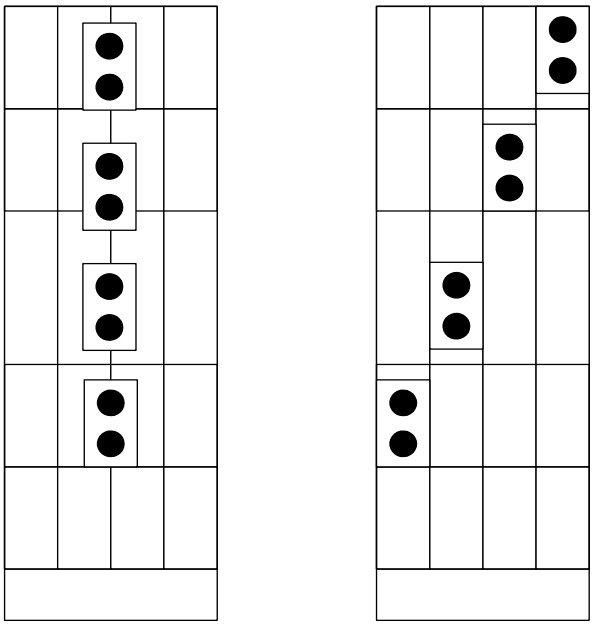

Figure 5: Two suggested methods of mounting electrodes

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4.0 Electrical Installation

4.1 General information

Section 1.1 of this user manual includes details of the power supply requirements, analog output characteristics (including load resistance) and relay specifications. Please refer to the terms electrode and sensor in the Glossary when reading this section.

4.1.1 Power supply and internal fuse

The CHS11 requires a clean stable 24 VDC power source. Details of the input supply including the current consumption and ripple are listed in Section 1.1. The CHS11 includes an internal self-resetting fuse for supply protection which is not field-replaceable.

4.1.2 Relays

There are 16 relay contact outputs that correspond to the 16 electrodes (see Figure 6). The maximum contact current and voltage for the relay contacts are provided in Section 1.1 of this manual.

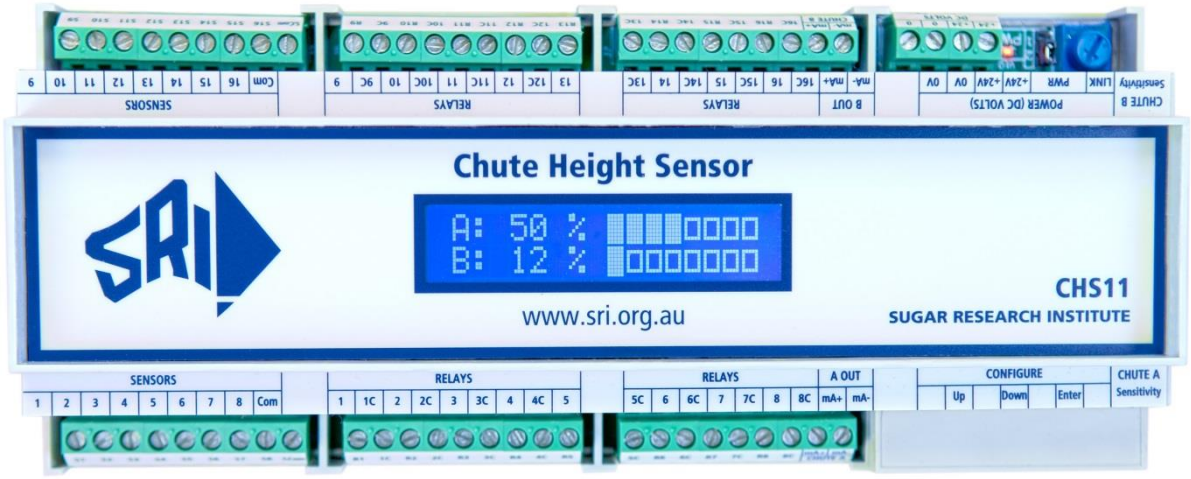

Figure 6: Relay outputs

NOTE:
Relay contacts are not suitable for mains-level voltages (110-240 VAC). Use a separate relay with the appropriate rating if switching mains-level voltages.

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4.2 Wiring Connections

The CHS11 uses screw terminals for the connection of power supply input, relay contacts, analogue outputs and electrode inputs. The terminal numbers and connections are shown in **Error! Reference source not found.**.

Table 1: Terminal connections

Terminal	Function
S1	Electrode 1 Input
S2	Electrode 2 Input
S3	Electrode 3 Input
S4	Electrode 4 Input
S5	Electrode 5 Input
S6	Electrode 6 Input
S7	Electrode 7 Input
S8	Electrode 8 Input
Com	Electrode Common A

Terminal	Function
S9	Electrode 9 Input
S10	Electrode 10 Input
S11	Electrode 11 Input
S12	Electrode 12 Input
S13	Electrode 13 Input
S14	Electrode 14 Input
S15	Electrode 15 Input
S16	Electrode 16 Input
Com	Electrode Common B

R1	Relay contact 1, N.O.
1C	Relay contact 1, Common.
R2	Relay contact 2, N.O.
2C	Relay contact 2, Common.
R3	Relay contact 3, N.O.
3C	Relay contact 3, Common.
R4	Relay contact 4, N.O.
4C	Relay contact 4, Common.
R5	Relay contact 5, N.O.

R9	Relay contact 9, N.O.
9C	Relay contact 9, Common.
R10	Relay contact 10, N.O.
10C	Relay contact 10, Common.
R11	Relay contact 11, N.O.
11C	Relay contact 11, Common.
R12	Relay contact 12, N.O.
12C	Relay contact 12, Common.
R13	Relay contact 13, N.O.

5C	Relay contact 5, Common.
R6	Relay contact 6, N.O.
6C	Relay contact 6, Common.
R7	Relay contact 7, N.O.
7C	Relay contact 7, Common.
R8	Relay contact 8, N.O.
8C	Relay contact 8, Common.
Chute A mA+	Analog Output A (+)
Chute A mA-	Analog Common A

13C	Relay contact 13, Common.
R14	Relay contact 14, N.O.
14C	Relay contact 14, Common.
R15	Relay contact 15, N.O.
15C	Relay contact 15, Common.
R16	Relay contact 16, N.O.
16C	Relay contact 16, Common.
Chute B mA+	Analog Output B (+)
Chute B mA+	Analog Common B

+24	+24Vdc Supply Input
+24	+24Vdc Supply Input
0	Supply Common
0	Supply Common

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4.2.1 Supply voltage input

Four terminals are provided for the connection of the 24VDC supply. Two are positive and two are negative (or common). The voltage supply may be floating or ground referenced.

4.2.2 4-20mA analogue outputs

There are two 4-20 milliamp analogue outputs referred to as 'Output A' and 'Output B'. When in single chute configuration, only the 'A' output is used. The 'B' output will be active but remain at approximately 4 milliamps. When being in dual chute configuration, both outputs A and B are used.

The analogue outputs of the CHS11 are isolated from the input supply but share a same common negative for both outputs. There are two terminals for each output. One terminal is for the current output and one for the signal return (common). The two common terminals are connected internally.

A single or twin twisted pair cable with screen for individual pairs and an overall screen is recommended for connection to the analog outputs. An example of a suitable cable type is Belden 9841 (single pair) and Belden 9842 (twin pair). For details please refer to www.belden.com.

4.2.3 Relay contact outputs

A single, normally open, dry, relay contact is available for each sensor. Each relay contact closes if its corresponding sensor is covered.

NOTE:
There are no internal fusing on the relay outputs and external fuses required to limit the current to the value listed in Section 1.1.

4.2.4 Electrode connections

The physical arrangement of electrodes is illustrated in Section 2 of this manual. A crimp lug and locknut are provided with the electrode for connection of 1.5 mm^2 plastic insulated multi-strand copper wires to the electrode. Each electrode requires one wire.

A connection must also be made between the steel chute and the CHS11 'sensor common' input. Two inputs are provided on the CHS11 for the sensor common for connections. If the CHS11 is used in single chute configuration, only one sensor common input needs to be connected. For dual chute configuration, both chutes need to be connected to the sensor common inputs. The sensor common must be connected using one of the conductors in the screened cable.

The wiring between the CHS11 and the electrodes should be multi-pair overall screened cable suitable for industrial environments. Recommended types include Belden 9539 (9 conductors each of 24 AWG). The length of the cable should not exceed 25 meters. The screen at the chute end of the cable should be left open circuit and the screen at the CHS11 end of the cable should be connected to the power supply common. To improve the mechanical connection of wiring to the electrodes, it is recommended to terminate the screened cable inside a waterproof junction box mounted on or near the chute. This allows more robust wires to be connected to the electrodes and the junction box

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terminals. Examples of a single chute installation wiring and dual chute installation wiring are provided in Figures 5 and 6, respectively.

4.3 Power-on checks

When the cable installation is complete, apply 24 volt power to the CHS11 and check the following:

- The 'PWR' LED on the CHS Module illuminates, showing that power is on; and
- The LCD illuminates (the LCD is back-lit) and the output screen (refer to Menu Reference for details) appears on the LCD screen.

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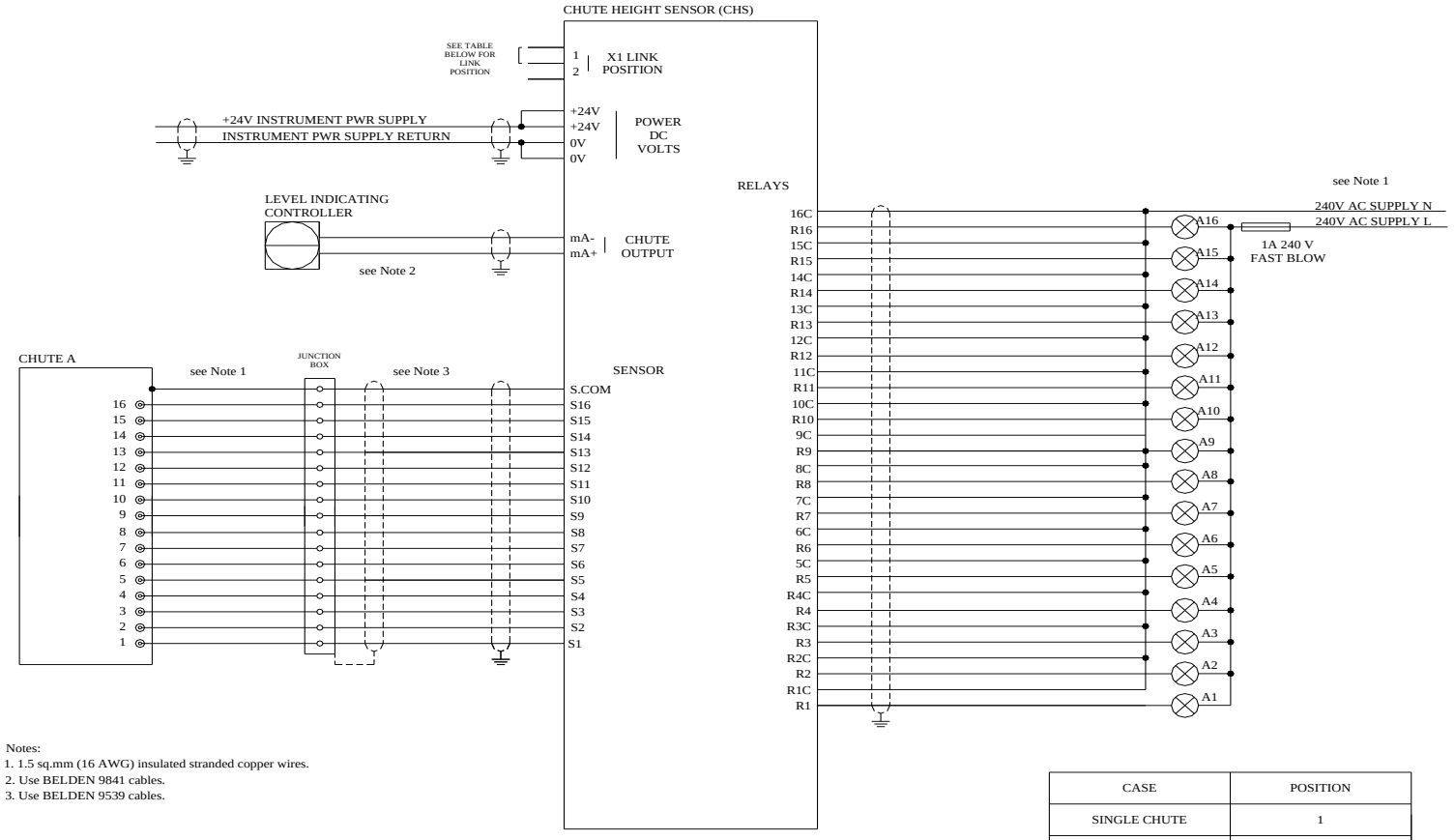
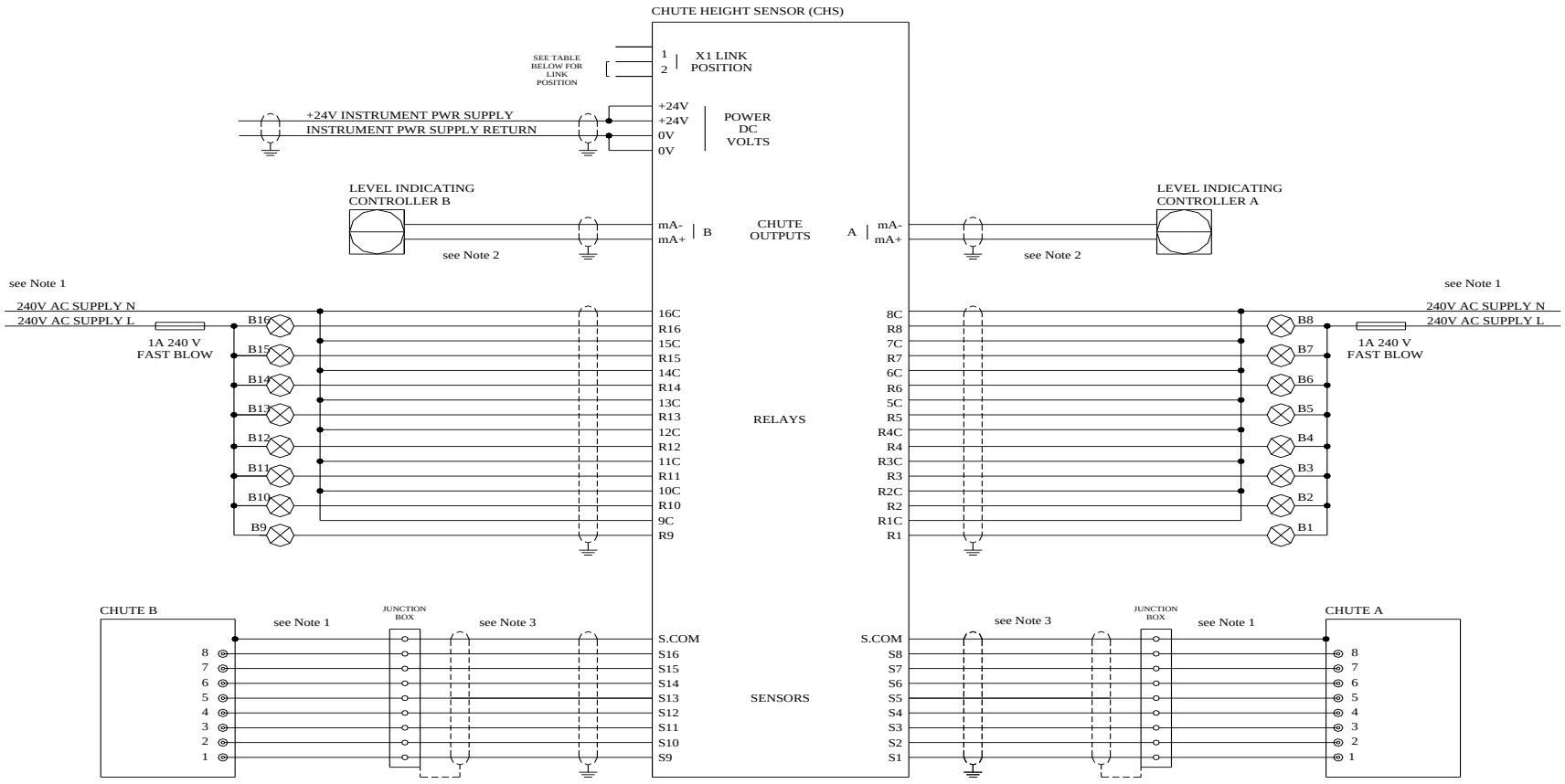
Installation Example – Single Chute



CASE	POSITION
SINGLE CHUTE	1
DUAL CHUTE	2

Figure 2: Single chute installation wiring example

Installation Example – Dual Chute



Notes:
1. 1.5 sq.mm (16 AWG) insulated stranded copper wires.
2. Use BELDEN 9841 cables.
3. Use BELDEN 9539 cables.

CASE	POSITION
SINGLE CHUTE	1
DUAL CHUTE	2

Figure 3: Dual chute installation wiring example

5.0 Commissioning

This section provides a concise guide on how to configure and adjust the CHS11 for a typical application. More detail is available in other sections of this manual including Section 5.

5.1 Overview

Prior to commissioning the CHS11, please check whether the mechanical and electrical installation is complete and the power on checks were satisfactory as described in Section 3.

The steps for commissioning a typical CHS11 installation include are:

1. Setting the jumper link 'X1';
2. Entering settings at the CHS11 user interface;
3. Adjusting the trimpots to a default position;
4. Adjusting the analog output zero and span;
5. Viewing the operation in Mode 4; and
6. Setting the mode of operation.

5.2 Setting the Jumper Link

The jumper link on the CHS11 selects one or two chutes as described in Table 1 below. If the CHS11 is used in the single chute mode, the jumper X1 must be fitted adjacent to the '1' text shown on the printed circuit board. For dual chute mode, fit X1 to the pins adjacent to '2'.

Table 1: Jumper link selections

Configuration	X1 position
Single Chute	'1'
Dual Chute	'2'

5.3 Entering Default Settings at the CHS11 User Interface

Please refer to the Menu Reference section of this manual for a concise reference to the user interface buttons and LCD screens. Use the interface to set the following values in Table 2 before commencing the commissioning process.

Table 2: Default settings for CHS user interface

Parameter/Setting	Single Chute Value	Dual Chute Value
Chute Configuration	Chute A Only	Chutes A and B
Num Sensors in A	Enter the number of electrodes wired to electrode inputs 1 to 8	
Num Sensors in B	Enter the number of electrodes wired to electrode inputs 9-16	
Detection Mode A	Mode 0	Mode 0
Detection Mode B		Mode 0
Damping Factor A	1 second	1 second
Damping Factor B		1 second
Threshold A	50 %	50 %
Threshold B		50 %
Hysteresis Low A	30 %	30 %
Hysteresis Low B		30 %
Hysteresis High A	70 %	70 %
Hysteresis High B		70 %
Zero Adjust A	50	50
Zero Adjust B		50
Span Adjust A	50	50
Span Adjust B		50

NOTE:
If the CHS11 is put into single chute configuration, the 'B' values will not apply.

5.4 Adjusting the Trimpots to a Default Position

Adjust the trimpots so they are mid-scale (i.e. in the middle of the range of rotation). The trimpots are located on the CHS11 module and are labelled 'VR1' (A) and 'VR2' (B). If the application is a single chute, only the A trimpot needs to be adjusted.

Observe the LCD which should display an output in per cent for either one or both chutes, and check that the output is zero and the output graphic is showing that no sensors are ON.

If the output is not 0%, turn the trimpots slowly anticlockwise until the output shows that no sensors are covered and the output 0%.

5.5 Adjusting the Analog Output Zero and Span

Monitor the analog output A using a suitable instrument. Increase the Zero Adjust A parameter (refer to Menu Reference section for details) until the instrument reads 4.0mA.

Now connect an 'earth' to the highest electrode in each chute and observe that all sensors are ON at the LCD output screen. The earth may be connected at the CHS11 or to the electrode wiring. Finally adjust the Span Adjust A parameter so that the output reads 20mA.

Repeat this process for analog output B for a dual chute configuration and adjust the parameters Zero Adjust B and Span Adjust B. In addition, remove the earth wire from the top electrode.

5.6 Viewing Operation in Mode 4

Now use the user interface to set the mode to 4 (for both chutes if in dual chute configuration). This allows the detection state (see Glossary) to be viewed and problem sensors can be identified.

At this stage in the commissioning process, there needs to be some method of observing the output from the CHS11 and the level of material in the chute simultaneously. A basic way of achieving this is to have an observer viewing the number of electrodes covered and a second person commissioning the CHS11.

When material is flowing through the chute (under normal operating conditions), observe the graphical representation of the sensors on the LCD and compare it with the observed level in the chute. As the chute fills and empties, the graphical representation should indicate sensors turning on and off.

5.7 Adjusting the Sensitivity Trimpots

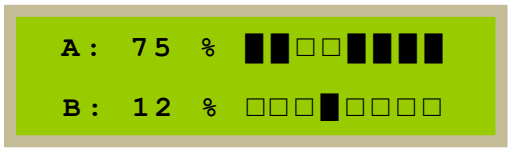
Adjust the trimpot and note that there is an 'A' trimpot (VR1) and a 'B' trimpot (VR2). For single chute applications only adjust the 'A' trimpot. For dual chute configuration adjust 'A' first and complete the commissioning before adjusting B.

Adjust the sensitivity whilst monitoring the output screen and the level of material in the chute until the CHS11 reliably shows the correct output. This should be performed over the entire range of operating conditions. If the material is wet, less sensitivity is required and as the material becomes drier, the sensitivity may need to be increased. The final sensitivity setting should accommodate both the wet and dry conditions.

NOTE:
Increasing the sensitivity means turning the trimpot anticlockwise and decreasing the sensitivity means turning the trimpot clockwise.

5.8 Check for Problematic Sensors: An Example

The following example shows a dual chute application where Chute A was full of material and Chute B was empty. Sensors 3 and 4 were found to be the problem in Chute A because some air pockets have been formed in the material around the electrodes. In this scenario, Sensor 4 in Chute B was observed to be always on, even when the sensitivity trimpot was turned almost fully clockwise. An example of how to check for problematic sensors is provided below.



For the example presented above, solutions were found for Chutes A and B.

Chute A Solution:

It was discovered that Chute A was configured for Detection Mode 1. Thus new electrodes were fitted to a different position at a later time in a location where the physical contact with the material was improved.

Chute B Solution:

The chute was emptied and the inside and outside surfaces were inspected and found to be free of excess water. Hence the electrode for Sensor 4 was removed and the insulator inspected in order to check for direct metallic contact between the electrode and chute wall. The electrode was refitted in accordance with the instructions in Section 2 of this manual and the problem was resolved.

5.9 Setting the Mode of Operation

For most applications, the mode of operation should be set according to the criteria presented in Table 4 which usually requires viewing the operation in Mode 4. In the criteria below, 'air pockets' means that the CHS11 indicates that one or more sensors are OFF when the level in the chute is above those sensors. 'Excess water' means that the CHS11 shows that one or more sensors are ON when the level in the chute is observed to be lower than the sensors.

Table 3: Mode of operation criteria

Mode → Criteria	0	1	2	3	4
All sensors properly detect the presence and absence of material. There are no problems observed from excess water or from air pockets.	✓✓	✓	✓	✓	×
Air pockets are sometimes a problem. The problem never occurs for more than one sensor at a time.	✓	✓✓	×	✓	×
Air pockets are sometimes a problem. The problem can occur for more than one sensor at the same time.	✓✓	✓	×	×	×
Excess water is sometimes a problem. The problem never occurs for more than one sensor at a time.	×	✓	×	✓✓	×
Excess water is sometimes a problem. The problem can occur for more than one sensor at the same time.	×	×	✓✓	×	×
Excess water and air pockets are sometimes a problem (*).	×	×	×	×	✓✓

***NOTE:**
The logic processing is not effective when trying to resolve the combination of air pockets and excess water. In this case it is recommended that the electrodes should be relocated or the source of excess water removed.

6.0 Configuration and Operation

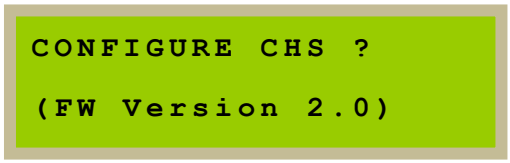
6.1 Configuration

The CHS11 is configured using the LCD and three button keypad which are located on the CHS11 electronics module board inside the enclosure. The LCD shows a number of parameter and options that can be set to suit specific applications.

NOTE:
Prior to the commissioning and configuration of the CHS11, the procedures outlined in Section 3 of this manual must be completed.

6.1.1 Entering Configuration Mode

The CHS11 enters configuration mode when the enter button is pressed at the configure CHS11 screen (see below).



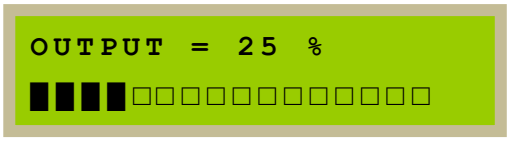
When the CHS11 is in configuration mode, parameters can be changed and adjusted. There is no interruption to normal operation of the CHS11 in the configuration mode.

The sequence of screens is explained in the Menu Reference section of this manual. Once in configuration mode, the user must go through all configuration screens before returning to the output screen. There is no automatic (timeout) return to the output screen. The entry to configuration mode can be aborted by pressing the 'Down' button.

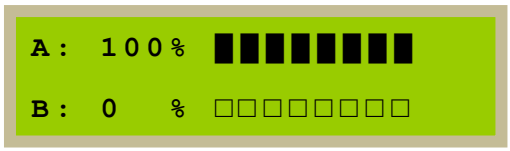
Section 4 of this manual provides a concise guide to setting the parameters for a typical installation. A more detailed description and guidelines for use of the parameters are provided in the Menu Reference section.

6.2 Operation

The operation of the CHS11 can be monitored using the output screen which displays the analog output values in per cent as well as a display of the sensors that are covered. Examples of output screens for single and dual chute configuration are provided below.



Single chute configuration



Dual chute configuration

The outputs are shown on the display as a percentage and as a graphical display of covered sensors. If in single chute configuration, only the 'A' output will be displayed. In dual chute configuration both A and B outputs will be shown. The graphical display resembles a bar-graph which has more functionality because it can be used to show the sensors that the CHS11 determines to be covered.

6.3 Sensor Detection and Logic Processing

The operation of the CHS11 is described below with reference to the Figure 12 which illustrates a functional block diagram.

The CHS11 comprises 16 conductivity sensing channels which may be used in a single chute, or split into 8 + 8 channels for a dual chute configuration. When in dual chute configuration, the detection state and output state registers are split into two groups of eight, and the logic processing and outputs are independent for each group. For brevity, the following descriptions refer to only to single chute configuration because the principle of operation is very similar for the dual chute configuration.

Each electrode is scanned in turn by connecting the electrode to the conductivity detector for a brief period of time. The measured conductivity is compared with the threshold value (a parameter that is normally set to 50%) and if the conductivity is greater than the threshold, the detector output is on. The recommended method of adjusting the detection is to change the sensitivity (using a trimpot) rather than the threshold parameter.

A programmable hysteresis algorithm is used to filter any momentary changes in conductivity. A 'sensor' is the combination of the electrode, sensitivity trimpot, detector and hysteresis algorithm. The output from the hysteresis algorithm is directed to memory registers that hold the detection state for each sensor. The detection state can be either 'covered' or 'uncovered'. The term 'covered' means that material was detected and 'uncovered' means that material was not detected.

The detection state is used as input for the logic processor which is used to minimise level detection errors if sensors are 'stuck' or behave erratically. Please refer to the Menu Reference section of this manual for a description of the modes of operation.

The output from the logic processor is held in memory registers called the output state. The LCD output screen shows the output state which is used by the analog and digital outputs. Each digital output is turned on when the corresponding sensor is ON.

The analog output block uses the number of sensors parameter to scale the output signal. The output is proportional to the number of sensors that are ON. For example, if the number of sensors is set to 12 and the output states for 6 sensors are ON then the analog output will be 12 milliamps (50%).

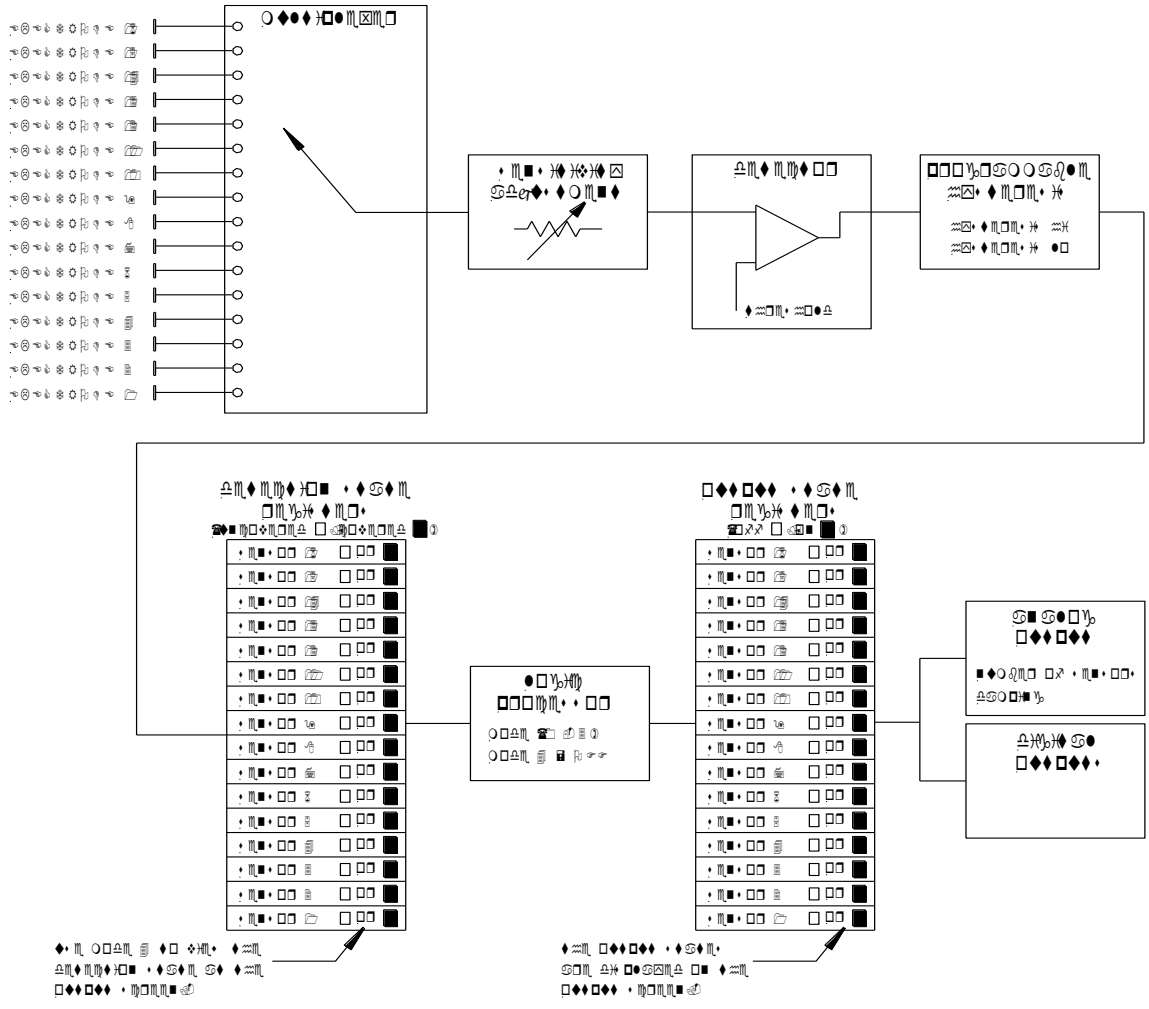


Figure 4: Functional Block Diagram of CHS11

7.0 Application Guide

The installation and configuration of a typical CHS11 application is described in the preceding sections of this manual (mechanical installation, electrical installation and commissioning).

This section provides some guidelines and background information on the use of a CHS11 for applications other than for monitoring the height of material in a feed chute. It also describes how to use the damping, threshold and hysteresis parameters.

7.1 Damping, Threshold and Hysteresis Parameters

7.1.1 Using the Damping Parameter

The analog outputs are proportional to the number of sensors. As one sensor turns on, the output will increase by an amount equal to 100%/the number of sensors. When the CHS11 is configured for a single chute with 16 sensors and each sensor turns on, the output will change by around 6%.

In addition, each analog output has a resolution of 10 bits and includes a damping algorithm that can be adjusted (using the damping parameter) to reduce the effects of the step changes. The algorithm is a first order low pass filter and hence increasing the damping time also delays the output response from the analog outputs.

As a result, it is normal to observe some minor ‘step changes’ in the output signal as the chute level changes. This will be most obvious when the output is recorded on a trend chart.

7.1.2 Using the Thershold Parameter

The CHS11 conductivity detector functions by generating an AC signal that is fed to the electrode inputs through the sensitivity trimpot (adjustable from 0 to 50k ohms). When material causes an electrical contact between an electrode input and the ‘sensor common’, a voltage divider is formed by the sensitivity trimpot and the material. This divided voltage is measured by the CHS11 and when it is reduced by an amount equivalent to the threshold, the conductivity detector will show that material is present.

Usually the threshold is set to 50% which means that material will be detected when it is the same resistance as the sensitivity trimpot setting. When the threshold is reduced, the material must be more conductive to be detected. Increasing the threshold may allow less conductive material to be detected.

It is recommended that the threshold is set between 10% and 90%. The effective detection sensitivity range for a given threshold setting is provided in Table 5.

Table 4: Sensitivity Range for threshold setting

Threshold (%)	Effective Sensitivity Range (kΩ)	Note
10	1.6	Minimum recommended setting
25	17	For wetter/more conductive materials
50	50	Default setting for most applications
75	150	For drier/less conductive materials

7.1.3 Hysteresis Adjustment

A hysteresis algorithm is used to filter the results from the detector. For example, if one sensor was covered with material but suddenly experienced an air pocket, the detector output may momentarily change to 'not covered'. The hysteresis algorithm filters out the momentary change and prevents the output state from 'chattering' or changing too rapidly.

Each time the CHS11 scans a sensor, the result from the detector is accumulated. The hysteresis algorithm compares the accumulated value with the hysteresis high and hysteresis low parameters to determine the detection state for the sensor.

If the accumulated result is lower than hysteresis low, the detection state is uncovered. If the accumulated result is greater than hysteresis high, the detection state is covered.

The default settings for hysteresis low is 30% which means that the detector output must be ON for less than 3 out of every 10 scans for the sensor to be 'uncovered'. The default for hysteresis high is 70% meaning that the detector output must be on for at least 70% of scans before the sensor is 'covered'.

Changing the hysteresis parameters has the following effects:

- The output state will change less rapidly if hysteresis low is decreased and/or hysteresis high is increased. This can be used to remove unwanted 'chatter' in the digital outputs that may be caused by momentary air pockets or material contact with the electrode.
- Increasing hysteresis low and/or decreasing hysteresis high means that the output state will be less resistant to change and may improve the speed of detection. This may be useful in fast flowing chutes where the reaction time of the CHS11 to changes in the chute level needs to be short.

7.2 Using the CHS11 for Materials other than Bagasse

The majority of CHS11 applications will not require knowledge of the following information, which provides details that may assist with difficult or irregular installations and applications. Please refer to Section 5 for a description of the CHS11 operation and background information on the CHS11 sensor detection and processing functions and terminology.

7.2.1 Characteristics of the Material for Reliable Detection

There are two main characteristics of materials that need to be considered in respect of suitability for CHS11 applications.

The first is the electrical conductivity, which is usually dependent on the amount of moisture and presence of ionic compounds (such as salts) contained in the material. Since the CHS11 has a conductivity detector that uses fixed values for threshold and sensitivity, there is a limit to the range of conductivity that the material may have for good detection. If for example the material is sometimes very wet and other times dry, it may be difficult to set the sensitivity adjustment that will provide consistent detection.

The second characteristic of importance is the physical characteristics of the material. Physical contact needs to be made between the material and each electrode to allow the CHS11 to detect conductivity between the material and to the chute (sensor common). The material also needs to fall cleanly away from the electrode surface when the chute level falls.

7.2.2 Electrode Surface Area

The CHS11 detects the conductivity between each electrode and the material in the chute. Increasing the electrode surface area has the same effect as increasing the sensitivity. Some CHS11 applications may require special electrodes with larger surface area (and therefore greater conductivity) so that the material can be properly detected. Examples of materials that may require large surface area electrodes include those comprised of spherical particles.

7.2.3 Using the CHS11 with Non-conductive Materials

The CHS11 may be used with other forms of detectors such as those described in Section 7 under ‘Interfacing with Proximity and Limit Switches’.

8.0 Application Briefs

8.1 Using the Relay Outputs

There are 16 relay contact outputs that correspond to the 16 electrodes. Typical uses for the relay outputs include:

- Providing a digital input to a control system (e.g. a programmable controller) to display the state of each sensor at an operator interface. Other logic processing (performed by the PLC/DCS) could be implemented to suit a specific application. The CHS11 would be in Mode 4 (no logic processing).
- Controlling a row of lights near the chute or in a control panel, allowing factory operators to see from a distance the level of material in the chute.
- High and low alarm indication could be used for outputs to indicate: chute empty, chute low, chute high, and chute full.

8.2 Material Presence Detection

The CHS11 comprises 16 sensors that can be used to detect the presence of material. When configured for operation in Mode 4 there is no logic processing and the relay outputs show the state of each sensor. For example, if sensors 1, 3, 7 and 15 are covered then relays 1, 3, 7 and 15 will be active and the other relays will be inactive.

It is therefore possible to use the CHS11 as a 16 channel sensor for level or presence detection. Some example applications are:

- Electrodes are fitted in the walls of tanks with one electrode per tank. When the material rises to a high level, the electrode becomes covered and the relay operates to provide an alarm indication of the high tank level.
- Electrodes are fitted in the walls of 8 tanks with each tank having two electrodes, one at the top and one at the bottom. The relays can be used for high and low level alarms for each tank.
- Electrodes are fitted to 4 chutes with each chute having 4 electrodes fitted as described in Section 2 of this manual. The relay outputs are connected to the digital inputs of a control system which converts the digital signals into levels of 0%, 25%, 50%, 75%, 100%.

NOTE:
For each of the examples provided above, the analog outputs would not provide a meaningful signal.

8.3 Interfacing with Proximity and Limit Switches

Because CHS11 electrodes detect conductivity, the sensor inputs can be connected to any circuitry or sensing element that has low conductivity in one state (e.g., 'ON') and high conductivity in another state (e.g., 'OFF'). Please observe the specifications in Section 1.1 for the electrode inputs. Ideally, the external circuitry will be from a voltage-free contact.
Examples of devices that may be connected between the electrode inputs and electrode common terminals include:

- Relays;
- Proximity switches (e.g., capacitive, inductive or ultrasonic);
- Photoelectric sensors with a volt free output;
- Limit switches; and
- Push buttons, selector switches and other operator controls.

8.4 Split Sensitivity Adjustment

As described in Section 3, the CHS11 module has a jumper link labelled 'X1' and two trimpots (VR1 and VR2) that allow separate sensitivity adjustment for sensors 1 to 8 and 9 to 16. The intended use of the separate adjustments is to allow the CHS11 to be used in dual chute configuration where the sensitivity in one chute may differ from that required on the second chute.

It is possible to use separate sensitivity adjustments for single chute installations. An example where this would be useful is where the lower eight electrodes require a low sensitivity but the electrodes towards the top of the chute require more sensitivity. The limitation when used in single chutes is that each trimpot A adjusts the sensitivity for sensor inputs 1 to 8 and trimpot B for sensor inputs 9 to 16.

8.5 Irregular Electrode Spacing

The CHS11 produces an output signal that is linear with the number of electrodes covered. If the electrodes are spaced at the same distance between electrodes, the output signal will be linear with the vertical distance in the chute. It is possible to mount the electrodes at distances proportional to the cross-sectional area of the chute so that the CHS11 output signal is proportional to the chute volume. In addition, it is possible to space the electrodes at irregular intervals to linearise the output signal with another process variable.

9.0 Keypad and LCD Reference

9.1 Keypad

Three buttons are provided on the CHS11 module for setting options and adjusting parameters. The position and names of the buttons are shown in Figure 13. The switches are placed at the bottom right hand corner of the CHS11 module (see Figure 13). The configuration of the keypad functions is provided in Table 6.

Figure 13: Configuration switches on CHS11 module

Table 5: Configuration keypad functions

Button	Function
Enter	Press to enter configuration mode and to scroll to the next menu item
Up	Increase the displayed value or answer 'Yes' to the question on the LCD. Also use to toggle between two options (e.g., single or dual chute configuration)
Down	Decrease the displayed value or answer 'No' to the question on the LCD

9.2 Flowchart of LCD Screens

Figure 14 outlines a flowchart of the user interface display operation with detail of each screen.

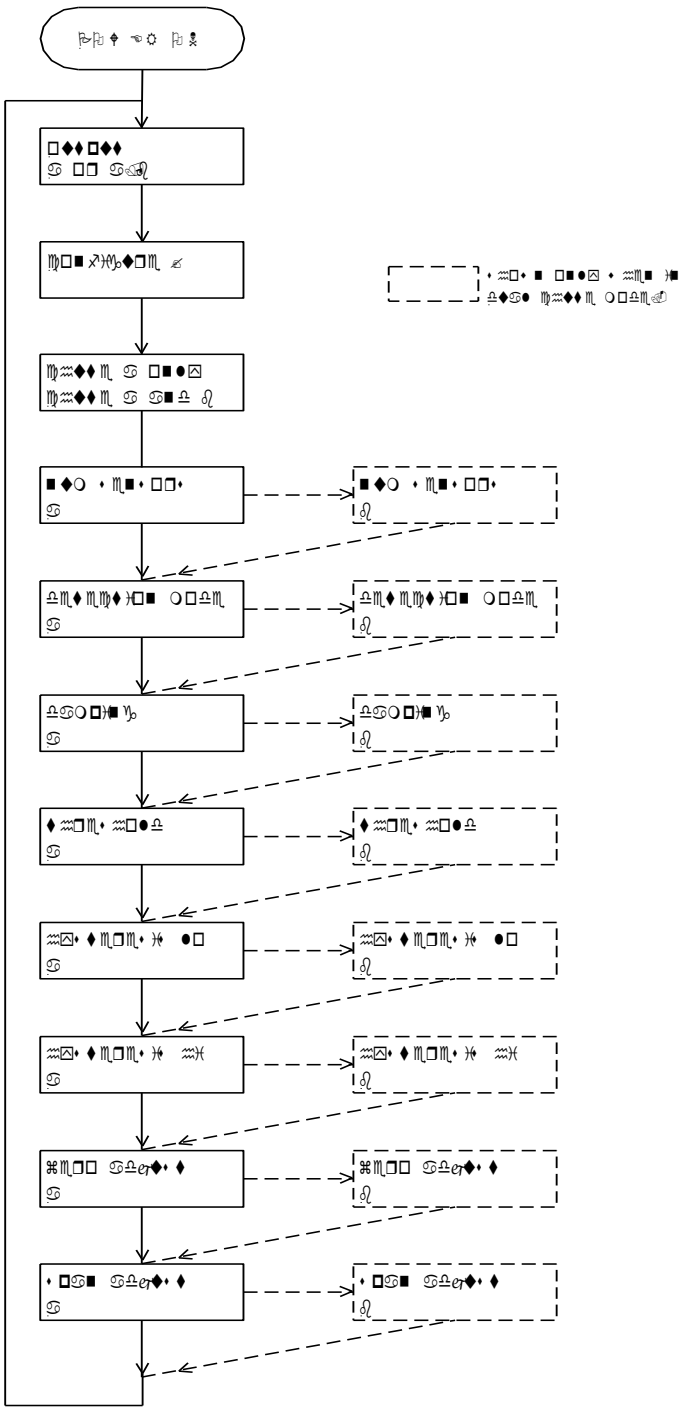
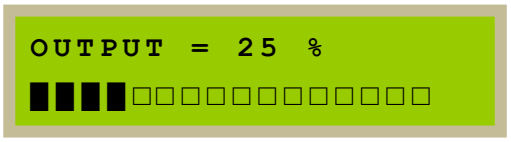


Figure 5: Flowchart of LCD Screens

9.3 LCD Screens

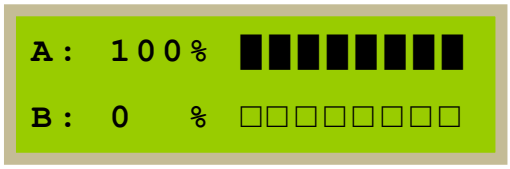
9.3.1 Output Screen

The output screen is shown after the CHS11 is powered up and is then the default display. If the CHS11 is configured for single chute mode, the screen will appear like this:



The first line of the screen shows that the output from the CHS11, which can range from 0 % to 100%. The second line shows a graphical representation of the sensors. In the example presented above, the CHS11 has been configured with 16 sensors. Sensors 1 to 4 are ON and sensors 5 to 16 are OFF.

In dual chute mode the output screen will appear like this:



The display shows that Chute A and Chute B are both configured for 8 sensors. Chute A is full (all eight sensors are ON) and Chute B is empty (all eight sensors are OFF).

9.3.2 Configure CHS11 Screen

By pressing the Enter button when the output screen is shown, the CHS11 configuration screen will be displayed which allows the user to enter the configuration mode or return to the output screen. The Firmware Version is also displayed here, as show in the following example:

By pressing the Up button, the CHS11 will enter the configuration mode. Note that the CHS11 will continue to scan the sensors and produce outputs when the CHS11 is in configuration mode so there is no interruption to the operation of the CHS11. Once being in configuration mode, the user must go through all configuration screens before returning to the output screen (see Figure 14).

Pressing the Down button will abort entry to the configuration mode and the output screen will be displayed.

9.3.3 Number of Chutes Selection

This screen allows the user to select either single chute or dual chute configuration. Pressing the Up button will toggle between the two options which appear as follows:

Note that changing this option will change the way the configuration screens are displayed. If in single chute mode (i.e. Chute A Only), the parameters for Chute B will not be displayed and cannot be changed because they will have no effect on the operation of the CHS11.

In addition, changing the configuration between single and dual chute configuration requires the X1 jumper selection on the CHS11 module to be changed. Please refer to Section 3 for more details.

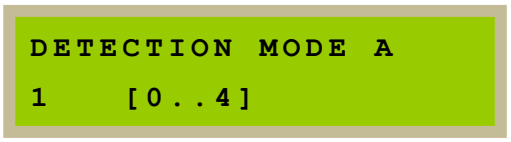
9.3.4 Number of Sensors

The number of sensors may be set for single and dual chute applications at the following screens:

The number of sensors is adjustable in steps of 2 sensors with a minimum of 4 sensors. The maximum number of sensors is 16 in a single chute configuration and 8 per chute for a dual chute configuration.

9.3.5 Detection Mode

The effect of the detection mode setting is described in Section 5 of this manual. The illustration below shows the current setting (the example shows Mode 1) in the second line and the range that may be set (between 0 and 4). Table 7 provides the detection mode and respective logic processing.



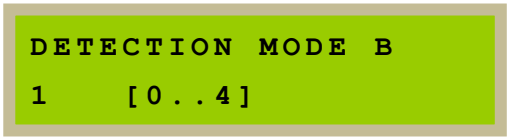


Table 7: Detection Mode and Logic Processing

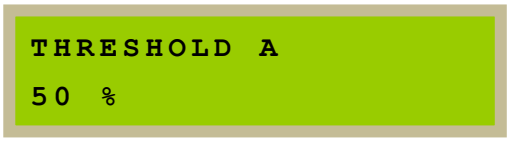
Mode	Logic Processing
0	Scan from bottom sensor to top sensor. Find the first sensor not covered and then set the output state for that sensor and all other higher sensors to OFF
1	Scan from top sensor to bottom sensor. Find the first sensor covered and then set the output state for that sensor and all other lower sensors to ON
2	Scan from bottom sensor to top sensor. Find two consecutive sensors that are not covered and set the output state for those sensors and all higher sensors to OFF
3	Scan from top sensor to bottom sensor. Find two consecutive sensors that are covered and set the output state for those sensors and all lower sensors to ON
4	No logic processing: the output state is the same as the detection state

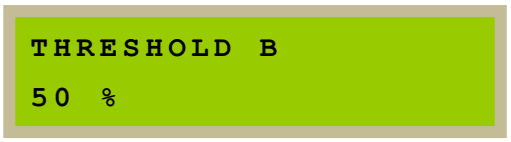
9.3.6 Damping

The output signal damping (see illustration below) is described in Section 5 of this manual. The range of setting is from 1 to 30 seconds. See the Application section of this manual for more detail.

9.3.7 Threshold

The detection threshold for the sensors (see illustration below) is described in Sections 5, 6 and 7 of this manual. It is normally set to a default value of 50%. The sensor detection is adjusted using the sensitivity trimpots. When the range of sensitivity adjustment is not sufficient it is possible to adjust the detection threshold.





9.3.8 Hysteresis Low

Hysteresis low is a parameter used by the sensor detection algorithm. Normally it is set to 30% (see illustration below) and this is the recommended setting for most applications. Please refer to the Applications section of this manual for more details.

9.3.9 Hysteresis High

Hysteresis high is a parameter used by the sensor detection algorithm. Normally it is set to 70% (see illustration below) and this is the recommended setting for most applications. Please refer to the Applications section of this manual for more details.

9.3.10 Zero Adjust

The zero adjust parameter (see illustration below) is used to adjust the 4 milliamp output signal when the output is at 0%. Details are provided in Section 3 of this manual.

9.3.11 Span Adjust

The span adjust parameter (see illustration below) is used to adjust the 20 milliamp output signal when the output is at 100%. More details are provided in Section 3 of this manual.

9.3.12 Configuration Error

The CHS11 stores parameters in non-volatile memory so they are maintained when the power is off. Parameters are verified when the CHS11 is powered up or when it enters configuration mode. If any parameter is not valid then the CHS11 will display the 'Config Error' message (see illustration below). When this occurs and the Enter button is pressed, the CHS automatically resets all invalid parameters to a default value.

10.0 Troubleshooting

Installation and operation of the CHS11 must be in accordance with the Specifications, Mechanical and Electrical Installation sections of this manual.

10.1 Self-test Function

A self-test function is provided to allow testing and checking of the electronics and connections. To enter the self-test mode press and hold the Enter button as power is applied to the CHS11 electronics. The self-test function performs the following actions:

- The relay outputs are turned on in a 'staircase' sequence (16 steps);
- The LCD shows the number of active relays;
- The analog outputs are ramped to match the relay settings;
- The sequence is repeated until the Enter button is pressed; and
- The speed of the sequence can be changed by pressing the Up or Down buttons.

10.2 Troubleshooting Guides

Symptom	**The LCD shows a 'CONFIG ERROR' message**
Possible Cause and Remedy	• The CHS11 stores parameters in non-volatile memory so they are maintained when the power is switched off. If that memory is corrupted then the 'Config Error' message is displayed. Press the Enter button to automatically restore the parameter to a default value.

Symptom	**There is nothing shown at the LCD and the LCD backlight is not lit.**
Possible Cause and Remedy	• Check that voltage is present at the CHS by opening the cabinet and checking the power on LED at the Module. If the LED is on then power is available: check the LCD cable connections at the rear of the LCD and at the Module connection. If the LED is off then power is not available at the input of the CHS or there may be some fault within the input protection portion of the Module. Remove power from the CHS and reapply whilst viewing the power on the LED on the Module. • Check that the 24 volt power connection is not reverse polarity.

Symptom	The 4-20 mA output does not function as expected
Possible Cause and Remedy	• If the CHS11 is configured for single chute and the analog output is always approximately 4 mA, it is most likely that the wrong output has been connected. Make sure that the Analog output A (not B) is connected for single chute applications. • If the CHS11 is configured for dual chute and the analog outputs appear abnormal then check that the connections from the outputs to the user equipment are not swapped. • The load resistance may be too high: outputs must be terminated with a resistance in the range listed in the Specifications section of this manual. • 24 volt power may be disconnected to the CHS: inspect the power on the LED at the CHS11 module – it should be on. • Check the analog output matches the output percentage displayed on the LCD output screen. • Check that the connection is not reverse polarity.

Symptom	As the chute fills the output changes erratically
Possible Cause and Remedy	• It is normal to observe some minor 'step changes' in the output signal as the chute level changes. This is because the analog output is proportional to the number of sensors: as one sensor turns on, the output will step up. The damping adjustment is provided to reduce the effects of the step changes but it also delays the response of the CHS11. • If the electrode wiring is not connected in the correct sequence, the output will behave erratically as the chute fills and empties. This can be checked by following the procedures detailed in the Commissioning section where the CHS11 is put into Mode 4 to check the operation of each individual sensor. • The output will change erratically if the sensor detection does not operate properly. For example if the sensitivity has not been adjusted to suit the range of operating conditions (e.g., bagasse moisture content), presence may not be properly detected at some or all sensors. Refer to the Commissioning section for more details.

Symptom	**The LCD shows that all sensors are OFF even when the chute is full or the LCD shows that some sensors are OFF even when material is contacting the electrode**
Possible Cause and Remedy	• If the sensitivity is too low (sensitivity trimpot is too far clockwise), material may not be properly detected. Check whether the sensitivity adjustment has been set as described in the Commissioning section of this manual. • The electrode wiring may be faulty or incorrectly installed. Check whether the electrode wiring is properly connected and the sensor common connection is connected to the chute. • The Threshold parameter may be set incorrectly. This will most likely be the case if the setting is too low. A threshold of 50% is recommended for most applications. For special applications please refer to the Applications section of this manual for more details on the threshold parameter. • The electrodes may not have good physical contact with the material. This may occur if the electrodes are fitted in a location where the material has large air pockets, or if the electrodes have been coated with some form of insulating material. Check the installation with reference to the Mechanical Installation section of this manual.

Symptom	**The LCD shows that all sensors are ON even when the chute is empty or the LCD shows that some sensors are ON even when material is not contacting the electrode**
Possible Cause and Remedy	• This may occur if the sensitivity is too high (sensitivity trimpot is too far anticlockwise). Check whether the sensitivity adjustment has been set as described in the Commissioning section of this manual. • The electrodes may be incorrectly installed or the electrode insulators may have failed. Check the installation with reference to the Mechanical Installation section of this manual. • Material may be deposited on the electrodes, or water may have gathered within the spaces between the electrode insulators and the steel chute. This will cause an unwanted path for electric current to flow and will result in false sensor detection. • The electrode wiring may be faulty or incorrectly installed. Check that the electrode wiring is connected properly and the sensor common connection is connected to the chute. Check for short circuits between the electrode wiring and sensor common and to earth. • The threshold parameter may be set incorrectly. This will most likely be the case if the setting is too high. A threshold of 50% is recommended for most applications. Refer to the Applications section of this manual for more details on the threshold parameter.

11.0 Frequently Asked Questions (FAQ)

Question: What are the cable specifications for the installation of the CHS11?

Analog Outputs: single or twin twisted pair instrumentation cable with screens for individual pairs and an overall screen is recommended. An example of suitable cable type is Belden 9841 (single pair) and Belden 9842 (twin pair). For details please refer to www.belden.com.

Electrode connections: use a multi-pair overall screened cable suitable for industrial environments. Recommended types include Belden 9539 (9 conductors each of 24 AWG) which allows for connection of eight electrodes plus one wire for sensor common. The length of the cable should not exceed 25 meters. The screen at the chute end of the cable should be unconnected. The screen at the CHS11 module end of the cable should be connected to the power supply common. To improve mechanical connection of the wires to the electrodes it is recommended to terminate the screened cable inside a waterproof junction box mounted on or near the chute. This allows more robust wires to be connected to the electrodes and then to the junction box terminal (e.g., 1.5 mm^2 plastic insulated stranded copper wire). Please refer back to the Electrical Installation for more details.

Question: Why does the display show that some sensors are not covered?

This may happen when the CHS11 is in Mode 4 which means that each sensor is displayed as it is measured by the detector. In other words, there is no logic processing. So if one sensor is not covered with material, it will show as not covered. The graphic display shows the output from the logic processing of the sensors but is not a bar-graph. The sensitivity adjustment may need to be changed because some sensors do not properly detect material.

Question: Where is the internal fuse of the CHS11 located and what spares are available?

The CHS11 module has one resettable fuse that is soldered on the printed circuit assembly. It is not field-replaceable.

Question: Why does the display not change when I hold down the Up or Down buttons?

There is no automatic increase or decrease feature on the CHS11. To change a parameter value you must push the button for every increase or decrease.

Question: Why does the CHS11 display not show the output screen that is mentioned in the manual?

Make sure that the CHS11 is not in configuration mode. The CHS11 does not automatically return to the output screen. Press the Enter button to return to the output screen.

Question: What does it mean when I get a 'Config Error' message on the display?

The CHS stores parameters in non-volatile memory so they are maintained when the power is off. Parameters are verified when the CHS11 is powered up or when it enters the configuration mode. If any parameter is not valid then the CHS11 will display the 'Config Error' message. When this occurs and the Enter button is pressed, the CHS11 automatically resets all invalid parameters to a default value.

12.0 Technical Definitions

Damping:

The CHS11 includes a first order low pass filter algorithm that is used to smooth the output signal. Damping refers to the time constant used for the analog outputs, which include a first order low pass filter. For example, when damping is set to 30 seconds, the output signal will fall to 37% of the initial value 30 seconds after the output state has changed.

Detection State:

The detection state Used describes which sensors are covered with bagasse and those that are not covered. It is determined by comparing the signal from the detection electronics against the threshold setting.

Electrode:

Steel electrodes are fitted to the chute and connected to the CHS11 electronics to detect the material presence.

Hysteresis:

The method used by the CHS11 to determine if a sensor is covered with material includes scanning the sensor a number of times. On each scan, the signal from the detection electronics is used to update an algorithm that has programmable hysteresis for determining whether the sensor is on or off. The output from this algorithm determines the detection state for each sensor.
The CHS11 has two hysteresis values: hysteresis high and hysteresis low. A hysteresis high value of 100 % means that the signal from the detection electronics must show that the sensor is covered for every scan before the detection state for the sensor is ‘covered’. A hysteresis high value of 70% means that the detection state will be ‘covered’ if 70% (or more) scans show the sensor is covered. Similarly, a hysteresis low value of 20% means that if 20% of scans show that a sensor is covered, the detection state for the sensor will be ‘not covered’.

Output State:

The CHS11 includes algorithms to convert the detection state into an output state based on the mode setting. The output state is used to control the relays and to generate the analog output. The two output states are ‘on’ and ‘off’.

Parameter:

A parameter in the CHS11 is a value which is stored in non-volatile memory and used by the CHS11 during operation to perform specific operations. Parameters can be changed at the user interface. Examples include the number of sensors, the detection threshold and hysteresis.

Scan/Scanning:

To determine the detection state, the CHS11 circuitry regularly scans each sensor in a continuous sequence.

Threshold:

The CHS11 compares the conductivity of each sensor with a threshold value. If the measurement is less than the threshold, the sensor detection state is ‘covered’. If the measurement is above the threshold, the detection state is ‘not covered’.